# MOBILE COMMUNICATION SYSTEM AND COMMUNICATION METHOD FOR MOBILE COMMUNICATION SYSTEM

## FIELD OF THE INVENTION

The present invention relates to a mobile station and a base station performing wireless communication, and a mobile communication system including a mobile station and a base station, and a communication method for a mobile communication system. Military and the state of

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#### BACKGROUND ARTS

As one of a communication system for the third was a second generation wireless communications (standardized by ITU-T as International Mobile Telecommunications-2000, or IMT-2000), the W-CDMA (Wideband Code Division Multiple Access) system has been adopted. In this W-CDMA, various techniques are introduced to improve communication quality (wireless transmission quality), which include soft handover (site diversity), site selection diversity control (SSDT), ea and closed-loop means 20 transmit power transmission power control.

The soft handover is a technique in which a mobile station is simultaneously connected with a plurality of base stations through wireless links, and receives signals 25 from the plurality of base stations using the RAKE receivers. At the time of the soft handover, the entire plurality of base stations performing the soft handover transmit signals

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on Dedicated Physical Channels (DPCH), and the mobile station receives the DPCH signals from the plurality of base stations.

The SSDT is a method for power control performed at the time of the soft handover, to solve a problem of increased interference on a downlink (i.e. a link directed to a mobile station from a base station) produced by the identical DPCH signals being transmitted to the mobile station from the plurality of base stations at the time of the soft handover. 10 The mobile station selects one of the base stations performing the soft handover as a primary cell, whereas we are other base stations are determined as non-primary cells and the sea Only the primary cell transmits signals on a Dedicated Physical Data Channel (DPDCH) in the DPCH, and non-primary cells do not transmit any DPDCH signals. Among the DPCH signals, Dedicated Physical Control Channel (DPCCH) signals are transmitted for the entire base stations performing the soft handover.

In the SSDT method, a mobile station measures the received signal code power (RSCP) of a Common Pilot Channel (CPICH) transmitted with constant power from each base station. The mobile station selects base stations of which measurement result is higher than the predetermined threshold as soft handover candidate. Among these soft 25 handover candidates, the mobile station selects the base station producing the maximum RSCP as primary cell. By changing (updating) the primary cell at high speed, the

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mobile station can receive the DPDCH with better reception quality.

The closed-loop transmission power control is a power control method performed in the following way: Both a mobile 5 station and a base station measure reception signal quality (i.e. transmission signal quality in terms of the transmission side). Depending on the measurement result, the bright of a transmit power control (TPC) command is transmitted to a transmission side so that a reception side can receive Make 4.410 a signal with desired quality. The transmission side then goest and a controls the ownstransmission power based on the TPC command\* 1818 1918 This control method aims to solve the far-to-near problem at the and reduce an effect caused by fading fluctuation. As a measurement criterion for the receive signal quality, the SIR (signal-to-interference power ratio) is applied.

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Here, in the conventional SSDT, particularly in an ... inner-loop control of the transmission power control on the downlink, a mobile station measures the SIR of the DPCCH received from a primary cell, compares the measurement which was 20 -value with a target SPR value, and generates an TPC command  $\sim$ in accordance with the comparison result. The mobile station then transmits this TPC command to both the primary cell and the non-primary cells through the uplinks (links directed to the base stations from the mobile station). According to the TPC command, the primary cell controls transmission power of the DPDCH and the DPCCH on the downlink. Meanwhile, the non-primary cells control the transmission

power of the DPCCH on the downlink, but do not control the transmission power of the DPDCH.

on the downlink at the time of the SSDT. A base station

5 selector 102 provided in a mobile station 100 measures the

RSCP of the CPICH transmitted from n base stations 2001

- 200n (where n is integer no less than 2), and selects

the base station producing the maximum RSCP value as primary

cell. The selection result of the primary cell is

transmitted to base stations 2001 - 200n on uplink feedback

information (FBI); in which identification information of

the base station indicating the primary cell is included.

Thus, each base station 2001 - 200n can identify whether

the base station of interest is the primary cell or the

15 non-primary cell.

An SIR measurement section 103 provided in mobile station 100 measures the SIR of the DPCCH transmitted from the base station which has been selected as primary cell by base station selector 102, among the DPCCH transmitted from base stations 2001 - 200n. SIR measurement section 103 then feeds the measurement result to a TPC bit generator 104. TPC bit generator 104 compares the measured SIR with a target SIR having been set in advance, and generates a TPC command based on the comparison result. The generated

In base stations  $200_1 - 200_n$ , an FBI bit extractor 204 extracts, from the received data, identification

information of the base station having been selected as primary cell. Based on this base station identification information, a switcher (SW) 203 determines whether or not the base station of interest is selected as primary cell.

- 5 If the base station of interest has been selected as primary cell, the base station concerned outputs a DPDCH data to a power controller 202, whereas if the base station concerned is not selected as primary cell, the base station is to accommodate concerned does not output any DPDCH data to power controller
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was the say and the Meanwhile, say TPC bit extractor 205 extracts the TPC bear and it and then feeds the TPC for the received data, and then feeds the TPC for the continued command to power controller 202. Power controller 202 controls the transmission power of the DPCCH according to 15 the TPC command. Power controller 202 further controls the transmission power of the DPDCH in case the DPDCH data is supplied from switcher (SW) 203 according to the TPC command. These power-controlled channel data are transmitted to mobile station 100 takes a second of the sec

> The power control by power controller 2020 is performed the section using the same control method, irrespectively of whether the base station concerned is the primary cell or the non-primary cell, according to the same TPC command (that is, the same increase/decrease amount of power based on 25 the same increment/decrement). FIG. 7 shows such a conventional power control method in a tabular form. Both the primary cell and the non-primary cell increase the

transmission power by 1 dB when the TPC command indicates '1', or decrease the transmission power by 1 dB when the TPC command indicates '0'.

As such, in the conventional SSDT method, the primary 5 cell selection is performed independently of the transmission power control. Namely, the primary cell selection is determined being referenced from the RSCP of the CPICH, whereas the transmission power control is performed by use of the TPC command determined by 10 referencing the SIR of the DPCCH. Moreover, the TPC command to be the rest of is transmitted on each time slot bases, and therefore the broken as gas the control is updated at each time interval & classical to a T of the time slot (for example, T = 0.667 ms). In contrast, the primary cell selection information is transmitted using the selection in the primary cell selection in formation is transmitted using the selection in the selection in the primary cell selection in formation is transmitted using the selection in the selecti 15 no less than three time slots, and therefore the primary cell is updated at time intervals three times as long as per transport of a transport of the contraction of the time interval T.

Now, according to the aforementioned method in which
the primary cell selection and the transmission power

control are performed independently, there lies a problem that an optimal primary cell selection cannot always be
quaranteed.

More specifically, although the base station transmitting the DPDCH signals with better quality has to be selected, according to the conventional method, the criteria applied for the transmission power control which effects the communication quality is different from the

criteria for the primary cell selection. As a result, there may be cases that a base station which provides better communication quality be not selected as primary cell.

Also, because the period of updating the primary cell is longer than the period of updating the transmission power control, there may be cases that updating the primary cell cannot follow the change of transmission power. As a result, a base station providing larger transmission power may not and the first of the property of the conbe selected as primary cell.

the dimension of the Further, because the primary cell update periods is a solution in long, there may also be cases that updating the primary to the preserving the cell cannot be follower fading of fluctuations . This may halsoned be all impede to receive the DPDCH signal transmitted from a base station providing larger transmission power.

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Also, conventionally, as having been illustrated in FIG. 7, both the primary cell and the non-primary cells perform identical transmission power control based on the common TPC command, which may possibly make it difficult to switch over from the primary cell to a non-primary cell. we can see 20 This emay reduce effect of high-speed cell selection to obtained by a rapid switchover of primary cell to more optimal base station.

> Moreover, because generally lower communication quality is provided by a non-primary cell than by the primary 25 cell, the transmission error rate for a TPC command may possibly be increased on the uplink also. In such a case, there arises a problem that the base station may perform

transmission power control based on an incorrect TPC command. As a result, greater transmission power difference than transmission loss difference may be produced between a plurality of base stations which are soft handover candidates. This may produce increased interference among the downlinks.

in the Technical Report of IEICE, RCS 2000-164, published by the IEICE (the Institute of Electronics, Information and Communication Engineers). According to the proposed method, which has been referred to as SIDTPC (site independent diversity transmit power control), a mobile station measures the SIR of the signal from each base station after the RAKE receiver, and generates the TPC command so that each base station can perform independent transmission power control.

However, according to this method having been proposed, it becomes necessary to provide a large amount of bits in a TPC command to be transmitted in the uplink DPCCH, which with the conventional method. Or, in order to make the number of the TPC command bits identical to the conventional method, the transmission power control period becomes longer, which may deteriorate capability to follow fading fluctuations.

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DISCLOSURE OF THE INVENTION

Considering the above-mentioned background, it is a

first object of the present invention to enable selection of a base station which transmits a user data signal with better quality, in a communication condition such that the user data signal is transmitted with power control from one base station selected from among a plurality of base stations by a mobile station.

It is a second object of the present invention to enable updating (switching) from the selected base station at high speed.

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, we say that mobile station has radio channels being set between a the many when mobile station and a plurality of base stations, and performs communication with the plurality of base stations, 15 in a communication condition such that one base station selected among the plurality of base stations transmits a user data signal which transmission power is controlled, and that the plurality of base stations including the selected base station transmit signals including a control makessar 20 data signal whichetransmission power is controlled incapacities to similar way as the user data signal. The mobile station includes: a measurement section measuring, on a basis of each base station, quality of the control data signal transmitted with the transmission power controlled; a 25 selector selecting the base station transmitting the user data signal, based on the quality of the control data signal from each base station measured in the measurement section;

and a transmitter transmitting identification information for identifying the base station selected by the selector, to the plurality of base stations.

In regard to the above-mentioned quality measurement, signal-to-interference power ratio is used in embodiment of the present invention, or reception power is used in another embodiment.

According to the first aspect of the present invention, the transmission of the user data signal from the base we shall be 10 station with transmission power controlled is performed by the war which make the based on the quality of the control datastransmitteds with a some parascribed that the transmission power controlled in assimilar waybas the follows. He user data signal. Therefore, as for the transmission of the user data signal, it becomes possible to select the 15 base station which can transmit user data signal with the best quality, and accordingly, the mobile station canreceive this user data signal with the best quality.

Preferably, the mobile station further includes a ··· serious generator which has preset target quality and compares the serious and  $\sim 8000 \sim 20$  -target quality with the quality of the base-station selected  $\sim 8000 \sim 100$ by the selector among the quality sets measured by the measurement section, generating power control information instructing to decrease the transmission power in case of the latter having better quality than the former, and instructing to increase the transmission power in case of the former having better quality than the latter.

In this way, the selection of the base station

transmitting the user data signal and the generation of the power control information are performed based on the quality of the identical control data signal. Namely, the criterion for the base station selection and the criterion 5 for the power control information determination are commonized (unified).

Preferably, the mobile station further includes a walk larger of generator generating power control information indicating was the t how the transmission power of the plurality of base stations selected by the selector among the quality sets measured was a sign washing the by the measurement section. The transmitter stores the basis is power control information generated by the generator, as well as the identification information, into each time slot was a larger than the slot was a larger th 15 in a frame having a plurality of time slots, and transmits the power control information and the identification information to the plurality of base stations.

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In this way, the identification information of the was the base station transmitting the user data signal discussion of  $m \sim m_{\odot} \sim 20$  .  $m \sim mit$  ted  $m \sim m \sim m_{\odot} \sim m_{$ time slot data, it becomes possible to select the base station transmitting the user data signal. Thus, it becomes possible to select the base station (updating, or substitution, of the base station) more rapidly than in the conventional method, and the aforementioned second object of the present invention can be achieved. As a result, it becomes possible to make the base station selection

follow fading variations.

According to a second aspect of the present invention, a base station has radio channels being set between the base station and a mobile station, and transmits a user 5 data signal which transmission power is controlled to the mobile station only when the base station of interest is selected by the mobile station, and also transmits, to the mobile station, signals including a control data signal which transmission power is controlled in a similar way details from 10 a as the suser data signal, irrespective of whether corunots and a was serious and the mobile station of interest is selected. The base station has a real responsible of mincludes: a receiver receiving identification information, seems on transmitted from the mobile station, representing the base station which is selected by the mobile station based on the second second state of the second secon 15 the quality of the control data signal transmitted with the transmission power controlled; and a transmitter transmitting the user data signal to the mobile station only when the identification information represents the \* 数据 100 全面 数据的 数据 124 平均 base station of interest.

According to the second aspect of the present invention, a communication method for a base station is disclosed.

The communication method is performed in each plurality of base stations, in a communication condition such that radio channels are set between the plurality of base stations and a mobile station, that a user data signal is transmitted which transmission power is controlled to the mobile station from one base station selected among the

plurality of base stations, and that control data signals, which transmission power is controlled in a similar way as the user data signal, are transmitted to the mobile station from the plurality of base stations including the selected base station. The communication method includes: receiving identification information, transmitted from the mobile station, representing the base station which The state of the ris selected by the mobile station based on the quality of the results the control data signal with the transmission power and the signal with the warm sendo controlled; wand when the identification information will be a same which was a represents the base station of interest; stransmitting the second second ground for my user datassignal with the transmission power controlled particle to and also transmitting the control data signal with the transmission topower controlled, whereas when the 15 identification information does not represent the base the Aleks of station of interest, transmitting the control data signal with the with the transmission power controlled, without transmitting the user data.

According to a second aspect of the present invention, correction > 20 other base station stransmitting the suser datassignal wise source is selected by the mobile station, based on the control data signal with the transmission power controlled similar to that performed against the user data signal. Thus, it becomes possible to select the base station capable of 25 transmitting the user data signal with the best quality, and the mobile station can receive the user data with the best quality.

Preferably, each of the base stations further receives in the receiver the power control information determined by the mobile station based on the quality of the control data signal, indicating how the transmission power is to 5 be controlled. The base station further includes a power controller which controls transmission power of both the user data signal and the control data signal, based on the power control information received by the receiver.

In this way, similarly to the first aspect, both the dividual results selection of the base station transmitting the user data was believed the task three it signal and the generation of the power control information where the t for the power control sofither base station are spenformed work when based on the same control data signal quality, and thus the criterions are commonized (unified) in the first of the common and the common are the common and the common are the common

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Further, preferably, the identification information of the base station transmitting the user data signal is received in each time slot of a frame having a plurality of timing sets. Thus, it becomes possible to select the base station transmitting the user data signal in each time st from st st 20 st slot st This enables sfaster-base station selections (update st sof the base station) than in the conventional method. As a result, updating the base station becomes easier to follow fading fluctuations than in the conventional method.

> In the second aspect of the present invention, according to a first preferred embodiment, when the identification information represents the base station of interest, the power controller controls to increase the

power in case of the power control information instructing increase of power, and to decrease the power in case of the power control information instructing decrease of power, whereas when the identification information does not 5 represent the base station of interest, the power controller controls to increase the power in case of the The part of power control information instructing increase of power; and the same and maintains the present power in case of the power control constitution instructing decrease of power. The Allert of the make the large to assecond preferred embodiment, when the large with a was visible to a sidentification information represents the base station of the same and were the expense minterest, athe spower scontrollers controls atomic reaseathe matrix of power in case of the power control information instructing increase of power, and to decrease the power in case of 15 the power control information instructing decrease of power,

Assemble whereas when the identification information does not the represent the base station of interest, in case of the power control information instructing increase of power, the power controller controls to increase the power with a identification information represents the base station of interest, and in case of the power control information instructing decrease of power, the power controller controls to decrease the power with a smaller decrement 25 than the decrement of when the identification information represents the base station of interest.

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According to a third preferred embodiment, when the

identification information represents the base station of interest, the power controller controls to increase the power in case of the power control information instructing increase of power, and to decrease the power in case of 5 the power control information instructing decrease of power, whereas when the identification information does not represent the base station of interest, the power remained to controller controls to maintain the present power in case where the of the power control information instructing either with a small 10  $\odot$  increase corrected as e of  $oldsymbol{ iny}$  over z=1 . When the last the water z=1 , z=1 , where

weaking the control As such, caccording to these preferred/embodiments, we have two sees what is it is set to perform different power controlabetween aim the water the base station selected by the mobile station and in the minute of a base station photo selected. Therefore, withhelecomes has a 15 unnecessary for the mobile station to generate and transmit individual power control information for each base station. This enables reduction of power control information field in each time slot.

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Also, with regard to the transmission power control which has 20% method based on the power control information, the method  $e^{i\phi}$  ,  $e^{i\phi}$ employed for the base station selected by the mobile station differs from the method for other base stations not selected. Accordingly, the transmission power control results in higher probability of any base station not selected 25 becoming substituted for the base station having been selected. In other words, updating the base station selection is promoted. Moreover, even when incorrect power

control information is transmitted due to an uplink transmission failure, the transmission power difference between the base station selected and the base stations not selected can be prevented from extending more than the degree of transmission loss difference. As a result, increase of the interference on the downlink can be avoided.

According to a third aspect, in a mobile communication

system having a plurality of base stations and a mobile of the

station, with radio channels being set between the eta , which 10 -plurality of base stations and the mobile station, in which eta and Takkusenage a user data signal disstransmitted with transmission power as as a care warrange was an acontrolled togethermobile station from Lone base station & large terselected among the plurality of base stations, and control And the control data signals, which transmission power is control red minute and a 15 a similar way as the user data signal, are transmitted to the mobile station from the plurality of base stations including the selected base station, the mobile station includes: a measurement section measuring quality of each control data signal on a basis of each base station; a second was the 20% selector selecting the base station transmitting the user source and data signal, based on the quality of the control data signal from each base station measured in the measurement section; and a transmitter transmitting identification information for identifying the base station selected by the selector 25 to the plurality of base stations. Each plurality of base stations includes a transmitter transmitting the user data signal to the mobile station only when the identification

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information transmitted from the mobile station represents the base station of interest.

According to the third aspect, in a communication method for a base station among a plurality of base stations, 5 with radio channels being set between the plurality of base stations and a mobile station, performed in a communication condition such that a user data signal which transmission and the second • \*\*\* \*\* power is controlled is transmitted to the mobile/station \*\*\* from one base station selected among the plurality of base equivalents. 10 instations; and that control data signals, which transmission will be seen the regression opened controlled in a similar-way as the user datassignal, a minor the of the table are transmitted to the mobile station from the plurality of the mobile. and the selected base stations including the selected base station, and the selected base station and the selected base station and the selected and the mobile station: measures quality of the control data and the quality of services 15 signals on a basis of each base station; selects the base services. was all a station transmitting the user data signal, based on the second of with the measured quality of each control data signal transmitted where the from each base station; and transmits identification information for identifying the selected base station, to realise result of the plurality of basesstations wand each plurality of base 48.400 real stations: when the identification information transmitted from the mobile station represents the base station of interest, transmits the user data signal which transmission power is controlled based on the power control information to the mobile station, and also transmits the control data signal with the transmission power controlled, whereas when the identification information does not represent the base

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station of interest, transmits the control data signal with the transmission power controlled, without transmitting the user data.

According to this third aspect, it is possible to obtain

5 the same functions and effects as in the first and second
aspects of the present invention.

According to another aspect, a mobile station of the

performing communication with a plurality of base stations includes: a measurement section measuring, on a basis of the section, quality of control data signals which are transmitted from the plurality of base stations addressed to the mobile station of sinterest and which transmission power is controlled; a selector selecting a base station transmitting a user data signal addressed to the mobile station of interest, based on the quality of the control data signals which are addressed to the mobile station of interest and measured in the measurement section; and a transmitter transmitting identification information for identifying the base station selected by the selector, to the plurality of base stations.

Further, according to still another aspect of the present invention, a base station performing communication with a mobile station includes: a receiver receiving identification information transmitted from the mobile station, representing the base station which is selected based on quality of control data signals which transmission power is controlled; and a transmitter when the

identification information represents the base station of interest, transmitting with the transmission power controlled, both a user data signal addressed to the mobile station and the control data signal addressed to the mobile 5 station, whereas when the identification information does not represent the base station of interest, transmitting the control data signal addressed to the mobile station at the second of the station of the second o with with the transmission a power controlled, inwithout does was all a transmitting any user data addressed to the mobile station factor of ingressation 10 roft interest. His metalogue in the entre of the end as a state of the estimate

Drawning to the Still further, Maccording to another daspect of the Miller in the nd marking a spresent ainvention and in a mobile communication asystem to the performing communication between a plurality of base. The Market Comparison of the Mobile Station, the Mobile Station: measures the transfer of 15 quality of control data signals, which are transmitted with was and was the transmission power controlled from the plurality of the control base stations and addressed to the mobile station of interest, on a basis of each base station; selects the base mobile station of interest, based on the measured quality and the measu of the control data signals which are transmitted from the plurality of base stations and addressed to the mobile station of interest; and transmits identification information for identifying the selected base station, to the plurality of base stations. The base station: when the identification information transmitted from the mobile

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station represents the base station of interest, transmits

with the transmission power controlled, both the user data signal addressed to the mobile station and the control data signal addressed to the mobile station of interest, whereas when the identification information does not represent the base station of interest, transmits the control data signal addressed to the mobile station of interest with the

addressed to the mobile station of interest with the transmission power controlled, without transmitting any user data addressed to the mobile station of interest.

Further scopes and features of the present invention of the present inv

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# BRIEF DESCRIPTION OF THE DRAWINGS

FIG.: 1/shows amblock diagram illustrating amportion and the mobile communication system according to an according to

A Page of the embodiment of the present invention. The beach of the present invention.

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FIG. 2A shows a frame format of an uplink DPCH (DPDCH and DPCCH).

4 (44.2) FIG. 2B shows another frame format of an uplink DPCCH and the state of the

or or the control of the control of

FIG. 4A shows a power control method according to an embodiment of the present invention.

FIG. 4B shows another power control method illustrated in a tabular form.

25 FIG. 4C shows still another power control method illustrated in a tabular form.

FIG. 5 shows a block diagram illustrating a portion

of a mobile communication system according to another embodiment of the present invention.

FIG. 6 shows an aspect of transmission power control for the downlink in case of the conventional SSDT.

FIG. 7 shows the conventional power control method illustrated in a tabular form.

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The preferred embodiment of the present invention is not limited to the present invention in the present invention is not limited to the present invention in the present invent

of the mobile communication system according to one embodiment of the present invention. This mobile communication system, as an example, employs W-CDMA (Wideband-Code Division Multiple Access), the communication standard of the third generation wireless communications (IMT-2000). The mobile communication system is provided with a mobile station 1, n base stations (where, n is an integer no less than 2) 2, - 2, and a radio network control unit (base station control unit) 3.

Mobile station 1 is exemplified by portable telephone, automobile telephone, and personal digital assistance, which perform radio communication with the entire base.

stations 2<sub>1</sub> - 2<sub>n</sub>, or a portion thereof, using the Code
Division Multiple Access (CDMA). This mobile station 1 is
provided with a receiver 11, m SIR measurement sections
12<sub>1</sub> - 12<sub>m</sub> (where, m is an integer no less than 2), a base
5 station selector 13, a switcher (SW) 14, a TPC bit generator
15, a transmitter 16, and antennas 17, 18.

Antenna 17 receives downlink signals (data).

transmitted:from base:stations 2<sub>1</sub> - 2<sub>n</sub> (hereafter each base station station 2<sub>1</sub> - 2<sub>n</sub> is generically referred to as base stations for station 2<sub>1</sub> - 2<sub>n</sub> is generically referred to as base stations for stations for stations and reception waves. Antenna 17 them states are supplied theoretically supplied from transmitter, 16 to base transmits uplink data supplied from transmitter, 16 to base to station 2 using the 2 GHz-band radio waves. Here, these stations antenna 17, 18 may otherwise be combined into a single antenna for both transmission and reception use chiefe a station and antenna for both transmission and reception use chiefe a station and antenna for both transmission and reception use chiefe a station and antenna for both transmission and reception use chiefe a station and antenna for both transmission and reception use chiefe and a station and antenna for both transmission and reception use chiefe and a station and antenna for both transmission and reception use chiefe and a station and a s

on the downward direction (downlink) include Dedicated

Physical Channel (DPCH), Common Pilot Channel (CPICH), etc.

20 The physical channels for the signals on the upward direction (uplink) include Dedicated Physical Channel (DPCH), Physical Random Access Channel (PRACH), etc.

The physical channels for the signals to be transmitted at the signals are the signals and the signal state of the signal stat

Each channel includes frames (radio frames) each having a plurality of time slots, and communication data are conveyed in these time slots. Each frame has a length of, for example, 10 ms, in which 15 time slots are included.

Both the uplink DPCH and the downlink DPCH are

individually assigned for each mobile station, and have Dedicated Physical Data Channel (DPDCH) and Dedicated Physical Control Channel (DPCCH).

One or more DPDCH are assigned for mobile station 1 which uses the DPCH, for use in conveying user data (voice data, character data, image data, etc.) of a user who uses mobile station 1. Meanwhile, one DPCCH is assigned for the large it will be some a mobile station. I which uses the DPCH processe in conveying the mediate and the first larger physical-layer control data in the DPCH. In the downlink, and the preresults for 40 of the DPDCH (and 6 the DPCCH) are time#multiplexed within one of all 8 to race is defeater time slots, whereas, in the uplink, the DPDCH and the DPCCH does were metrices who are I/Q-multiplexed on lastrame-by-frame basis: operations or have Like Lite Floring to the time confethe SSDT (site selection diversity... Like 50) starts (limb at transmit spower acontrol); the DPDCH is settled lymbetween say; who 15 mobile station 1 and base station 2 having been selected and the station 1 and base station 2 having been selected as a selec or leading to the last primary cells (hereafter referred to as primary cells 2), etcls and its

or the same of the whereas the DPDCH is mot set between mobile station 1 and the same of t base station 2 determined as non-primary cell (hereafter And the property of the proper

FIG. 2A shows the frame structure of the uplinksDPCH (DPDCH and DPCCH). As described earlier, each radio frame has a plurality of time slots (15 time slots, TS). Each time slot includes I/Q-multiplexed data of the DPDCH and the DPCCH.

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25 The DPDCH includes user data, as described earlier. The DPCCH includes a pilot bit of a known pattern used for channel estimation in the pilot symbol aided coherent detection, a transport format combination indicator (TFCI), a transmit power control (TPC) bit (or TPC command) of base station 2, and feedback information (FBI).

The FCS bits represent identification information indicating primary cell 2 selected at the time of the SSDT. As this identification information, for example, a temporary cell ID assigned for each base station 2 at the second time of the SSDT is used. Namely, the base station having the temporary cell ID represented by the FCS bits is the primary cell, and other base stations are the non-primary cells.

FIG. 3 shows the frame structure of the downlink DPCH.

25 Similarly to the uplink DPCH, the downlink DPCH radio frame includes a plurality of time slots (15 time slots, TS).

In each time slot of the downlink DPCH, the DPDCH and

the DPCCH are time-multiplexed, as described before. The DPCCH includes TPC bit, TFCI, and pilot bit for mobile station 1.

Now, receiver 11 performs amplification, de-spreading,

5 RAKE combining, frequency conversion, A/D conversion, etc.

against the signals received by antenna 17. Receiver 11

supplies the DPDCH data included in the reception signal

to a data processor, and supplies the DPCCH data to SIR

Data processor performs predetermined process against and the cafter outputs voice data included a managed at a character data, image data, etc. included in the data onto in a display unit (not shown) such as a liquid crystal display where the character data in the data onto included in the data onto in

The reception signal of the DPCCH is Rake-combined and the station 2 man decreased by receiver 11 on a basis of each base station 2 mand receiver thereafter demultiplexed into the DPCCH data of each base station

1. The demultiplexed DPCCH data of each base station

2. The demultiplexed DPCCH data of each base station

For example, the DPCCH of base station  $2_1$  is supplied to  $2_2$  is supplied to SIR measurement section  $12_1$ , the DPCCH of base station  $2_2$  is supplied to SIR measurement section  $12_2$ , and so on.

The above value m is set equal to the number of base stations 2 to be selected as candidate for soft handover, i.e. the number of the active sets. Therefore, in ordinary cases, m is set smaller than n (m < n). Further, even on receipt of signals from more than m base stations 2, receiver

11 selects the radio waves received from m base stations
2. Thereafter receiver 11 performs RAKE combining against
the signals received from each base station 2, and supplies
the Rake-combined signals to SIR measurement sections 12,
5 - 12m.

Here, the active sets are updated periodically, as when it is divided into the state of mobile station 1 moves. Also, when one cell is divided into the state of the state of sectors, each divided sector is assigned as active set.

sequence of the same sure mental sections of the same section of the same sure mental section of the same sure and sure sequence powers. The same sure and sure sequence powers of the same sure and sure sequence powers of the same sure sequence powers of the same sure sequence powers of the same sure sequences. The same sure sequences are sequences of the same sequences of

Base station selector 13 determines the maximum value

of the SIR by comparing m SIR data supplied from SIR data s

Here, the identification information assigned to each base station 2, for example the temporary ID, is notified

in advance both to base station 2 and mobile station 1 from radio network control unit 3. In addition, when there are two or more base stations 2 producing the identical maximum SIR value, any arbitrary one of base stations 2 is selected as primary cell. Base stations 2 other than primary cell 2 become non-primary cells.

place to the FCS bits supplied by base station which was

of reference selector 13; switcher 14 sets the own switch condition so the sets of

that the SIR of primary cell 2 indicated by the FCS bits approximate is noutput to TPC bit generator 15. Thus withe maximum SIR passence of Obligated with a value is supplied to TPC bit generator 15 via switchers 4. Fed white a ogaileand cannot be a le IncTRC bistagenerator:15, a a target SIR determinedabyature it , ik, a graditus inon-illustrated outer-loop transmission power control is the plane we ari for an reason set in advancer: TRCabit generator 15 compares the maximum are ablastua  $_{
m color}$   $\sim$  15  $^{\circ}$  SIR value supplied from switcher 14 with the preset target  $\sim$   $\sim$   $\sim$   $\sim$ m with m SIR. When the maximum SIR value is greater than the target  $\mathbb{R}(1)$  with  $\mathbb{R}$ The first of SIR, TPC bit generator 15 outputs to transmitter 16 others are TPC bit '0' (DOWN bit), which is an instruction to decrease or converte with the transmission power. Whenethe maximum SIR evalue piscent of within  $\cos (c_0) \cos (20)$   $c_0$  smaller than the target SIR; TPC bit generator (15) outputs  $\cos (3c_0) \cos (3c_0)$ to transmitter 16 the TPC bit '1' (UP bit), which is an instruction to increase the transmission power. When the maximum SIR equals to the target SIR, whichever instruction of increasing or decreasing the transmission power is applicable. One of the instructions is set in advance in TPC bit generator 15.

The DPDCH data supplied from the data processor, as

well as data related to other channels (not shown), is input to transmitter 16, in addition to the FCS bits supplied from base station selector 13 and the TPC bit supplied from TPC bit generator 15. The DPDCH data includes voice data input by the user from a microphone (not shown), image data input from an imaging device such as a CCD camera, and the . Jakoba ta a talike. A CAMBANA A COMMAND STATE OF A STATE OF A STATE OF

with twist  $x \in \mathbb{R}^{n}$  . Transmitter 16 performs processing against with escape put  $x \in \mathbb{R}^{n}$  . such as frequency conversion, spreading, aD/America data, respond 10 conversion, Corthogonal modulation, coandramplification, and the second conversion of the c where taking a Transmitter 16 then transmits the processed data (to bbase space in a 

The TPC bit and the FCS bits are transmitted on the last the second of the last the second ramaratikan ar a »DPCCH as shown jinaFIGS: 2A, r2B explained dearlier..i.a r #2 ha a 25 1.2

The TPC bit consisting of one bit is included in each and any from normalist time slot inconesframe (for example, each: timesslots in 15% at our momake make time slots). Musing this TPC bit transmitted in each time is 1920 as slot, base station 2 can perform transmission power control, was two cases as will be described later: For example, in cases that one is the case www.com. 20% frame lengthm/insterms of time)wis 10 ms, mand one frame a same of includes 15 time slots (i.e. 1 time slot = 0.667 ms), the transmission power control is performed at the rate of 1,500 times per second.

> Also, as for the FCS bits, the entire bits are included 25in each time slot in one frame. Namely, in one time slot, the FCS bits necessary for identifying each of m base stations 2 of active sets are included. For example, when

m = 8, the FCS bits of at least 3 bits are included in one time slot. Thus, using the FCS bits included in one time slot, each base station 2 can determine whether the base station concerned is selected as primary cell. As a result,

5 the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyses of the power control is performed using the TPC bit (for example or and analyses of the power control is eachieved; and analyses of the primary cell is eachieved; and analyses of the same intervals as the analyses of the primary cell is eachieved; and analyses of the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyses of the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the primary cell is updated at the same intervals as the analyse of the primary cell is updated at the same intervals and the primary cell is updated at the primary cell is upda

in the second configuration, sincluding transmitter 2/1, spower controllers in the second configuration, sincluding transmitter 2/1, spower controllers in the second configuration and the se

and supplies the received data to a receiver 26. Antenna control of the control o

المنظم المنظم المنظم المنظم Antenna 28 receives uplink signals (data) transmitted المنظم المنظم المنظم المنظم ا

Receiver 26 performs the same processing against the reception data as receiver 11 in mobile station 1 described earlier. Receiver 26 then supplies the received DPDCH data to radio network control unit 3, and also supplies the received DPCCH data to TPC bit extractor 25 and FCS bit extractor 24.

Radio network control unit 3 transmits the received

DPDCH data to the base station 2 concerned, or another base station 2, or a non-illustrated core network. reception data is finally transmitted to another mobile station, or a server, terminal, etc. in another 5 communication network (for example, the Internet).

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TPC bit extractor 25 extracts the TPC bit from each to the time slot of the DPCCH, and supplies the extracted TPC bit plant was to power controller 22. FCS bit extractor 24 extracts the angle of the control of or region with the FCS bits from deach time slote of the DPCCH; and supplies with the constrandaller of the extracted FCS; bitsito switcher; 23; and power control:lers from areas a

1数的磁轮旋旋2000 (199**.)** មានមានក្រុម មានមានអ្នកមានមានមានមានក្រុម ប្រជាជាក្រុម ប្រជាជាក្រុម ប្រជាជាក្រុម ប្រជាជាក្រុម

The transmission data of the DPDCH supplied: from madio data of the DPDCH supplied: from madio data at no bulled a renetwork control unit. 3 is input to switcher 23 printaddition has been a tablata for the the: FCS abits a supplied of rom a FCS. bit vextractor 2.2.2 a copyred of a same

Switcher 23 determines whether the FCS bits supplied and a second from FCS bit extractor 24 are identification information Moreover of indicative of the base station concerned. Switcher 23 sets was a low the own setting conditions depending on the above empositions to a determination result; has described in the following: Till and the fo the identification information represented by the FCS bits with the resulting the resu specify the base station concerned (in other words, if the base station concerned has been selected as primary cell), switcher 23 supplies the DPDCH transmission data to power controller 22. On the other hand, if the identification information represented by the FCS bits does not specify the base station concerned (in other words, if the base station concerned is a non-primary cell), switcher 23 does

not supply the DPDCH transmission data to power controller 22. With these settings, the SSDT is performed, and the DPDCH transmission data is transmitted from the primary cell only, and not transmitted from any non-primary cells.

Because the FCS bits are supplied to switcher 23 at entioned above-mentioned above-mentioned above-mentioned above-mentioned which will be a determination, whether the base stations concerned disather and show cers noted to primary occell, whandstathe disetting whether outher DPDCH was a most and the stransmission data is to be supplied to spower controller as seen a http://www.nc.10 22.aresperformedwate the intervalssofathe time sakotss (for we sake to or Allerto Beerample, 0.667 ms or 1,500 times per second) Maint such carry the and where we do not way, updating of the primary cell is performed at the time was here Allian of Slot intervals. The same all the control of the way below notical regarders of rewWhen there are lauplurality of mobiler stations which prisered it

tripulation of transmission data with regard to the plurality of Mobile Annalis and Annalis stations are input to switcher 23. At the same time, the way is the FCS bits and the TPC bit in the DPCCH are transmitted from withe plurality of mobile stations. In this case, switcher ( ) as a second Fig. 5. The  $1.20^\circ$  : 23 is ets: whether or moti the DPDCH transmission data for teach  $1.60^\circ$  is  $1.60^\circ$  . mobile station is to be supplied to power controller 22, based on the FCS bits from each mobile station. For example, when a mobile station A selects base station  $2_1$  as primary cell, whereas a mobile station B does not select base station  $2_1$  as primary cell, switcher 23 in base station  $2_1$  supplies the DPDCH transmission data for the mobile station A to power controller 22, whereas switcher 23 does not supply

aggreence 15 are communicating with one base station 32, withe DRDCH and a communicating with one base station 32, with a DRDCH and a communicating with some base station 32, with a draw of the state of the state

Stage with a test of

25

the DPDCH transmission data for the base station B to power controller 22.

The DPCCH transmission data is also input to power controller 22 of base station 2 from radio network control

5 unit 3, in addition to the TPC bit supplied from TPC bit extractor 25, the FCS bits supplied from FCS bit extractor 25, the FCS bits supplied from FCS bit extractor 24, and the DPDCH transmission data supplied from switchers 24, and the DPDCH transmission data supplied from switchers 25, the FCS bits supplied from switchers 24, and the DPDCH transmission data supplied from switchers 25, the FCS bits supplied from switchers 24, and the DPDCH transmission data supplied from switchers 25, the FCS bits supplied from switchers 25, the FCS bits supplied from switchers 26, and the DPDCH transmission data supplied from switchers 25, the FCS bits supplied from switchers 26, and the DPDCH transmission data supplied from switchers 26,

Same a in 10. In a Based on the FCSabits and the TPC bitteinput; power about an appropriate controller 22 controls the transmission power of both the base the base of the DPDCH transmission data and the DPDCH transmission data are a supplied from switcher 23, to increase or decrease the control of the base are about transmission power and the base of the base prospects.

FIG.: 4A: shows a power control method according to the masses of the present invention in a tabular form. Power control as the present invention in a tabular form. Power control as the present invention in a tabular form. Power control as the present in the base of the present in the base of the present in the base of the present in the present in the FCS bits. Also, power control as primary cell, using the present in the FCS bits. Also, power control as 22 determines whether the present in the FCS bits. Also, power control as 22 determines whether the present in the FCS bits. Also, power control as 22 determines whether the present in the present in the FCS bits. Also, power control as 22 determines whether the present in the pre

When the TPC bit is '1', power controller 22 in primary cell 2 increases the transmission power of both the DPDCH and the DPCCH by 1 dB, whereas when the TPC bit is '0', power controller 22 decreases the transmission power of both the DPDCH and the DPCCH by 1 dB.

On the other hand, in non-primary cell 2, switcher 23 inhibits to input the DPDCH data to power controller

22. Accordingly, power controller 22 in base station 2 of non-primary cell does not perform the transmission power control for the DPDCH (power control is set Off). Meanwhile, power controller 22 in non-primary cell 2 performs 5 transmission power control for the DPCCH in the following Additional manner. When the TPC bit is 11', power controller 22' Fig. 48. Application of the control TPC bit is 40% repower controller 22 neither increases norwand coldens decreases the DPCCH transmission powered (that hais, with the new manual of 等限では1998年10 minorease/decrease amount his 走り(dB) and かりゅうがほうにはあると Addition しょうしょ Conditions of the Additionally plassfor the transmission power pantupper so take to and a limitais set win advance in power controller 22%. When the section of war of the latter power value is to exceed the upper limit; power controller and take the I mission in . 22 does not increase the power, despite the TPC bit oblive the pw rea The transmission data of the DPCCH and the DPDCH, to seem the control of the cont the water of a which the above-mentioned power control has been performed by the performance of the p

To transmitter 21, in addition to the DPCCH data (and er existed from the the DPDCH data) yadata related to other channels ((not shown)), existing the fire 20 are supplied. Transmitter 21 performs the same processing when these as for mobile station 1 described earlier against these channel data, and transmits these channel data via antenna 27.

25

to brown the control supplied itor transmitter/21: to which should be discommon that the control of the control

As such, inner-loop power control is performed in a closed loop formed of receiver 11, SIR measurement section 12, switcher 14, TPC bit generator 15, and transmitter 16 in mobile station 1, and also in a closed loop formed of

receiver 26, TPC bit extractor 25, power controller 22 and transmitter 21 in base station 2.

According to the embodiment of the present invention, transmission power control is performed in a different management of manner between in the primary cell and in the non-primary cell, against the common TPC bit. Accordingly, it is not see that the common TPC bit accordingly, it is not see that the common TPC bit accordingly is the sent that the common the common that the control of the common that the control of the common that the common that the common that the control of the common that the common t

Further, in non-primary cell 2, the transmission powerolagous and is anot decreased when the TPC bit is 200' so whereas them the action of transmission power is increased when the STR of non-primary and the stransmission power is increased when the STR of non-primary and the stransmission power is increased when the STR of non-primary and the stransmission power is increased when the STR of non-primary cell 2 become greater than the STR of primary cell 2 being and the stransmission of primary cell 2 becomes greater another words and the second secon

Further, even when an incorrect TPC bit is transmitted

due to a transmission failure in the uplink, the

transmission power difference between the primary cell and

the non-primary cell can be prevented from extending more

25 than the degree of transmission loss difference. As a result,

increase of the interference on the downlink can be avoided.

For example, even when an incorrect TPC bit of '0' is

transmitted to the non-primary cell due to a transmission
failure, despite the correct value '1', the transmission
power of the non-primary cell is not decreased. Accordingly,
it becomes possible to avoid an excessively large amount
of variation in the transmission power difference produced
between the primary cell and the non-primary cell.

Moreover, according to the embodiment of the present.

invention, the selection of primary cell 2 is performed.

based on the SIR, which is one of reception characteristics.

base station 2 having the maximum SIR value is selected.

as primary cells There is a correlation between whether the SIR of the DPCCH is large (that is, whether the SIR of the DPCCH is large (that is, whether the SIR of the similar power control is performed,

communication quality is good) and whether the SIR of the similar power control is performed,

is large. Therefore primary cell 2 having been selected;

based on the SIR of the DPCCH is to provide good communication quality of the DPCCH. Thus, on the occurrence of the SSDT,

it becomes possible for mobile station of to receive the service of the SDT,

it becomes possible for mobile station which provides good

Further, according to the embodiment, selection of the primary cell 2 is performed at the time slot intervals.

Accordingly, updating of primary cell 2 is performed more rapidly than that performed in the conventional method. It becomes possible to follow fading variations at higher speed than before. Even when the fading varies abruptly,

the limited at communication quality. The first the second section of the more than the second

updating the primary cell at high speed makes it possible to avoid a bad influence to the communication quality.

in a tabular form. The transmission power control in base 5 station 2 acting as non-primary cell is different from the power control method shown in FIG. 24A, athough withes a station 2 selected as a primary cell visuidentical Namely, the DPCCH transmission are reconstructed.

ing sivers in power in mon-primary cell 2 is increased by 10.25 dBawhen and the same and the sam

errinalistic con**tro bitmis**. #**0**%-fame domination of the Control Harry American is a standard of

transferment of the contrast this emethody ether power his decreased to as greatern has a swar

promote easier substitution of the primary cell. Moreover, and the decreasing the transmission power. This can also and the same transmission power that the decreasing the transmission power that the decreasing the transmission power that the decreasing the transmission power than the decreasing the transmission power that the decreasing the transmission power than t

FIG. 4C shows still another power control method illustrated in a tabular form. According to this method, when base station 2 is a non-primary cell, the DPCCH transmission power is controlled to be invariable, irrespective of the TPC bit of '1' or '0'.

With this method also, the power is decreased to a

greater extent in the primary cell than in the non-primary cell, in case of decreasing the transmission power. This can also promote easier substitution of the primary cell. Moreover, even when an incorrect TPC bit is transmitted 5 due to an uplink transmission failure, the transmission to the street of power difference between the primary cells and the street research the common primary cell-canabe prevented from extending more than the the common telliness of the common section of the com nowinders on withe degree of stransmission doss difference. Ascal resulty we have the was marked to the interference increase on the downlink can be avoided that the life with lpha and  $oldsymbol{1}$  . As another embodiment of the present invention, mobile lpha , lpha and lphastation 1 selects apprimary cell by comparing the DPCCH select by applications of apower, other than the SIR of the DPCCH wEIG. 5 shows and lock and the six diagram illustrating a portion of the mobile communication and the communication of the mobile communication and the communication of the mobile communication and the communication of the communicat named appropries resystem according to withis halternative sembod mentiof the water withproceeding 15 present invention. The present invention of the contract of the

ensumers of a identical symbols are assigned to configuration elements are made in identical to those shown in FIG. 1, and detailed description e devices an a of these configurations elements is omitted as In the mobile at submark. size = 200 + 20 + communication system shown in FIG2-5, whifteently from that 200 + 200shown in FIG. 1, the SIR measurement sections  $12_1 - 12_m$ in mobile station 1 in FIG. 1 is replaced by power measurement sections  $19_1 - 19_m$  in FIG. 5, so as to measure the DPCCH reception power (RSCP: received signal code power) received in receiver 11.

makes were really as In the mobile communication system shown in FIG: 650 case and the

With this configuration, a base station selector 20 determines the maximum power value among m power values

25

measured in power measurement sections  $19_1 - 19_m$ , and outputs as the FCS bits the identification information of base station 2 corresponding to the maximum power value. Also, a TPC bit generator 30 compares the target power value having ... 5 been set in advance by a non-illustrated outer-loop make the state of transmission power control, with the maximum power evalue as any order was a stake to selected by switcher 14. A TPC bit 10/2 is coutput when the tell in the memory limits maximum power value is greater than the target power value per make a associated with whereas a TPC bit of this coutput when the maximum power avalue is carried as /A., ambd 砂紅O. is smaller than the target power value. Other configuration (and a mark). 1400-4776 (318 % selements insboth smobile stations 1 and base stations 2 marely a second a eathre bearing resimilar (to) those, shown in (EIGoal) - citair as Archanasa, sherar rish (air a which shall make the within this whalternative himment he high-speed has all and ational referrities election cofficer primary: cell thaving agood communication may be able was 11 15 quality can be attained, in a similar way to the mobile and the same will four Tyres communication system shown in FIG. of the membrace oryginal reasons to - the transfer of m . Additionally, p in the description of the embodiments - h r - d - r r rhaving been illustrated, the reception characteristic of emorphism . The DPCCH is measured. However, it may also be possible to prove the name of the control o reception power RSCP, etc.) of other channels on which the transmission power control is performed in a similar way

Further, in the foregoing description of the embodiment, W-CDMA is applied as prerequisite. However, the present invention is not limited to the W-CDMA system. The present invention may also be applicable for the Code

to the DPDCH.

Division Multiple Access (CDMA) systems as a whole, including the multi-carrier CDMA. Also, it is possible to apply the present invention to other communication systems, such as the Orthogonal Frequency Division Multiplex (OFDM) employed as transmission technique for ground-wave digital broadcasting.

## WELT-WIRE SEED TO CONTROL OF THE FOLD WINDUSTRIAL APPLICABILITY CONTROL OF THE SEMINAR MEDICAL CONTROL

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756.福林树的"温明","我们们,我们也不知识,我们们是一个人的。" "这一个人的 "我们,我们们的一个人的,我们们们的一个人,我们们的一个人,我们们们们们们

The state of the communication system, as well as a mobile station (portable: a writing of the communication system: For example, otherwise as a communication system: For example, otherwise as a communication of the com

According to the present invention, selection of the base station stransmitting a user data signal with power way a a control is performed based on the quality of the control according to that performed against the user data signal. Therefore, as for the user data signal, it is possible to select the base station which can transmit the user data signal with the best quality, and the mobile station can receive the user data of good quality.

Also, according to the present invention, in a

communication condition in which user data signal is transmitted from one base station selected by the mobile station among a plurality of base stations, updating (switching) from the selected base station can be performed

5 at high speed.

ruther, according to the present invention, a criterion for selecting the base station transmitting the criterion of sthe control user data signal and a decision criterion of sthe criterion of sthe criterion are commonized; and criterion are commonized; and criterion are selected. The foregoing description of the embodiments is not are intended to limit the invention to the particular details.

The foregoing description of the embodiments is not are intended to limit the invention to the particular details.

The foregoing description of the examples illustrated. Any suitable modification and criterion are covered by the appended claims.

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